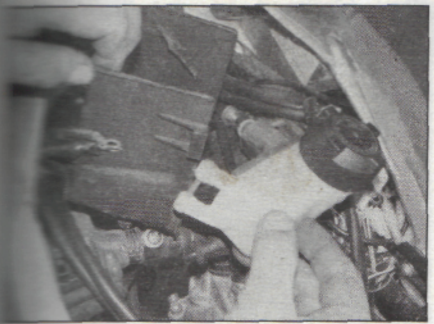
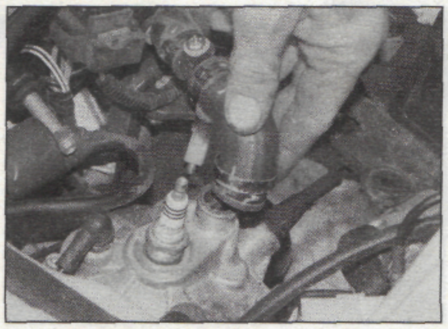
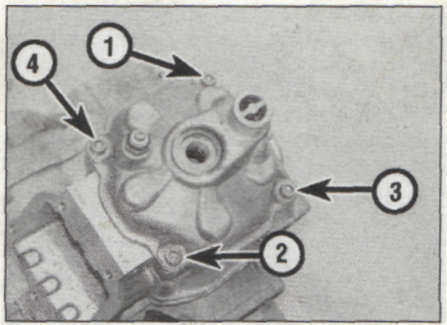

6.4 Remove the battery carrier and coolant reservoir


6.5 Disconnect the coolant hose from the cylinder head



6.8a Undo the head cover bolts in a criss-cross sequence . . .

6 Cylinder head

Note: *This procedure can be carried out with the engine in the frame. If the engine has been removed, ignore the steps that don't apply.*

Caution: The engine must be completely cool before beginning this procedure or the cylinder head may become warped.

Removal

1 Remove the fairing side panels (see Chapter 8).

2 Remove the fuel tank and the air filter housing (see Chapter 4).

3 Remove the battery (see Chapter 9).

4 Drain the cooling system (see Chapter 1). Disconnect the coolant hose to the coolant reservoir from the water pump union on the right-hand side of the crankcase (see Chapter 3). Remove the bolt securing the battery carrier and lift out the carrier and coolant reservoir **(see illustration).**

5 Disconnect the coolant hose from the union on the cylinder head **(see illustration).**

6 Either loosen or remove the spark plug – make sure your spark plug socket is the correct size before attempting to remove the plug (a special plug spanner is supplied in the tool kit which is stored under the passenger seat).

7 Pull back the rubber boot on the coolant temperature sensor wiring connector and disconnect it **(see illustration 4.11).**

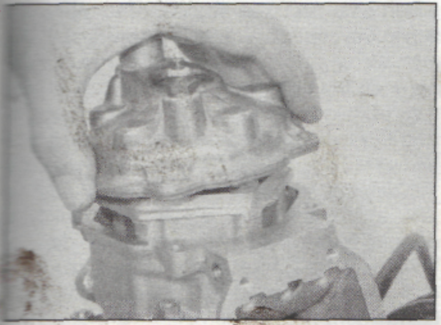
8 Undo the head cover bolts evenly and a little at a time in a criss-cross sequence until they are all loose and remove them, then lift off the cover **(see illustrations).**

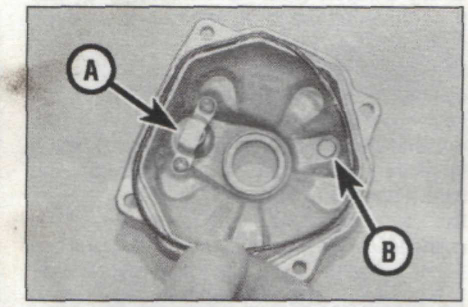
9 Remove the head cover and spark plug seals and discard them as new ones must be fitted on reassembly **(see illustrations).**

10 On Type 122 engines, undo the head bolts evenly and a little at a time in a criss-cross sequence until they are all loose and remove them and the washers **(see illustration).** On Type 123 engines, undo the head nuts in the same sequence and remove the nuts and washers. **Note:** *If a nut has become stuck on a stud and the stud unscrews from the cylinder, follow the procedure in Section 7, Step 13 to refit the stud before installing the cylinder head.*

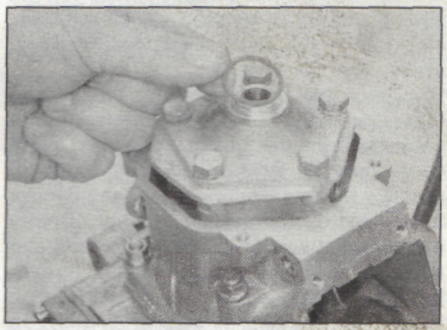
11 Lift off the cylinder head **(see illustration).** If the head is stuck, tap around the joint face between the head and the cylinder with a soft-faced mallet to free it. Do not attempt to free the head by inserting a screwdriver between the head and cylinder – you'll damage the sealing surfaces.

12 Remove the cylinder head seal and discard it as a new one must be fitted **(see illustration).**

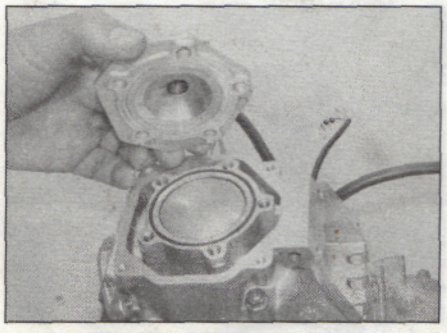

6.8b . . . and lift the cover off

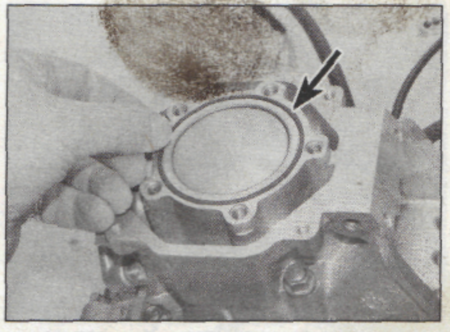


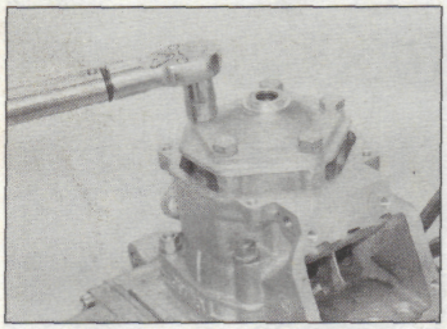
6.9a Remove the seal from inside the head cover. Note the thermostat (A) and temperature sensor (B)


6.9b Remove the seal from the spark plug location

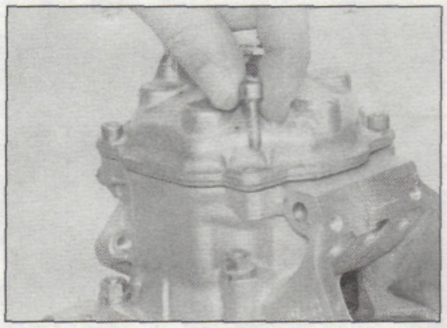
6.10 Remove the cylinder head bolts and washers – Type 122 engine


6.11 Lift off the cylinder head


6.12 Remove the cylinder head seal (arrowed)



6.20 Tighten the cylinder head fixings to the specified torque setting



6.22 Install the cylinder head cover bolts

Inspection

13 Remove all accumulated carbon from the cylinder head carefully using a blunt scraper – if required, follow the procedure in Chapter 1, Section 27, and decoke the piston and exhaust port.

Caution: The cylinder head and piston are made of aluminium which is relatively soft. Take great care not to gouge or score the surface when scraping.

14 Inspect the head very carefully for cracks and other damage. If cracks are found, a new head will be required. Inspect the spark plug threads; stripped plug threads can be repaired with a thread insert of the Heli-Coil type – refer to an Aprilia dealer or specialist motorcycle engineer.

15 Check the sealing surfaces on the cylinder head and cylinder for signs of leakage, which could indicate that the head is warped. Using a precision straight-edge, check the head sealing surface for warping. Check vertically, horizontally and diagonally across the head, making four checks in all.

16 Check the head cover for cracks and other damage The coolant temperature sensor and the thermostat are located in the cover **(see illustration 6.9a)**. If required, unscrew the temperature sensor and remove it – discard the sealing washer. Before installing the sensor, clean the threads and apply a suitable non-permanent thread-locking compound, then fit a new sealing washer and tighten the sensor securely. To remove the thermostat, undo the two fixing screws and lift it out. Tighten the fixing screws securely on installation. Refer to the procedures in Chapter 3 to test the sensor and the thermostat.

Installation

17 Lubricate the cylinder bore with a smear of the recommended two-stroke oil.

18 Ensure both cylinder head and cylinder sealing surfaces are clean, then carefully fit the new cylinder head seal into its groove in the top edge of the cylinder **(see illustration 6.12)**.

19 Locate the head on the top of the cylinder – ensure that the edges of the head align with the inner edge of the cylinder water jacket **(see illustration 6.11)**.

20 Install the washers and cylinder head nuts/bolts as applicable, and tighten them finger-tight. Now tighten the nuts/bolts evenly and a little at a time in a criss-cross pattern to the torque setting specified at the beginning of this Chapter **(see illustration)**. Note that the torque setting is different between Type 122 and Type 123 engines.

21 Fit the new spark plug seal onto the cylinder head **(see illustration 6.9b)**. Fit the new head cover seal into its groove in the edge of the cover **(see illustration 6.9a)**. If necessary, use a dab of grease to hold the seal in position.

22 Locate the head cover on the top of the cylinder – ensure the seal remains in position – then install the cover bolts **(see illustration)**. Tighten the bolts evenly and a little at a time in a criss-cross pattern to the specified torque setting.

23 Install the remaining components in the reverse order of removal. Note that the hose clips commonly used on Aprilia motorcycles are of the crimped variety – they must be secured with special crimping pliers **(see illustration)**. Don't forget to refill the cooling system (see Chapter 1, Section 34) before fitting the fairing side panels.

7 Cylinder

Note 1: *This procedure can be carried out with the engine in the frame, although access to the cylinder base nuts is extremely restricted. If the engine has been removed, ignore the steps that don't apply.*

Note 2: *Aprilia supply three different thicknesses of cylinder base gasket to ensure the correct compression ratio is obtained. Check that all three gaskets are available to avoid delays on reassembly.*

Removal

1 Drain the cooling system (see Chapter 1). Remove the radiator (see Chapter 3).

2 Remove the carburettor, the exhaust system and the exhaust manifold (see Chapter 4).

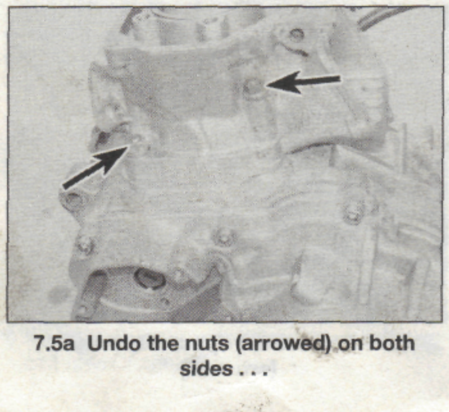
3 On unrestricted (20kW) machines, remove the exhaust port RAVE valve (see Chapter 1, Section 12).

4 Remove the cylinder head (see Section 6).

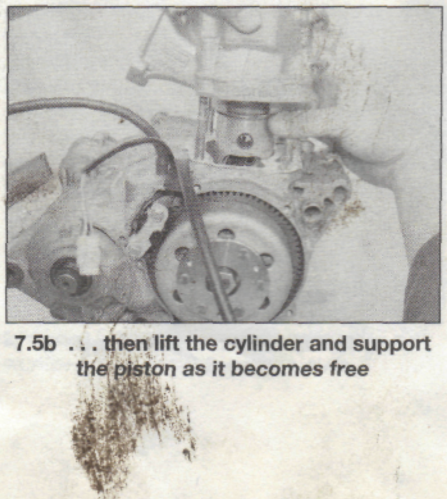
5 Undo the four cylinder base nuts and remove the nuts and washers, then lift the cylinder up off the studs, supporting the piston as it becomes accessible to prevent it hitting the crankcase **(see illustrations)**. If the cylinder is stuck, tap around the joint face between the cylinder and the crankcase with a soft-faced mallet to free it. Don't attempt to free the cylinder by inserting a screwdriver between it and the crankcase – you'll damage the sealing surfaces. When the cylinder is removed, stuff a clean rag into the crankcase opening to prevent anything falling inside.

6 Remove the gasket and discard it as a new one must be used on reassembly **(see illustration)**.

7 Undo the bolts securing the intake manifold and reed valve assembly and lift them off (see

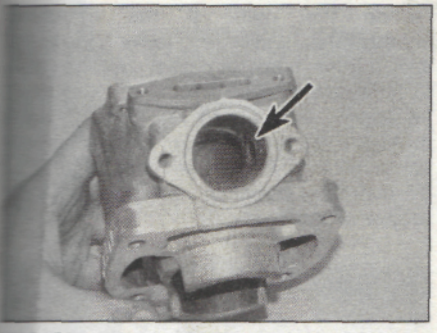


7.5a Undo the nuts (arrowed) on both sides . . .

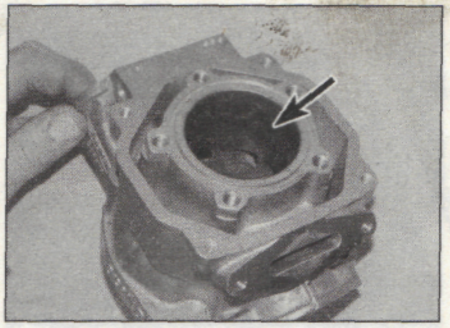


7.5b . . . then lift the cylinder and support the piston as it becomes free

7.6 Remove the old gasket and discard it



7.8 Clean any carbon out of the exhaust port (arrowed)



7.9 Inspect the cylinder bore (arrowed) for scratches and score marks

Chapter 4). Discard the gasket as a new one must be used.

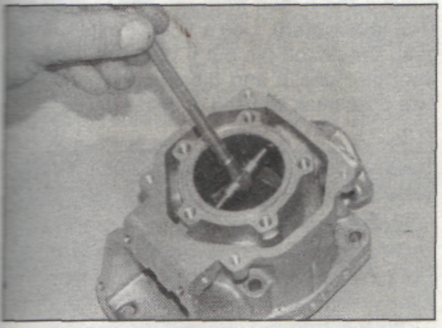
8 Scrape out any carbon deposits that may have formed in the exhaust port **(see illustration)**. Wash the cylinder with a suitable solvent and dry it thoroughly. Compressed air will speed the drying process and ensure that all the holes and recesses are clean.

Inspection

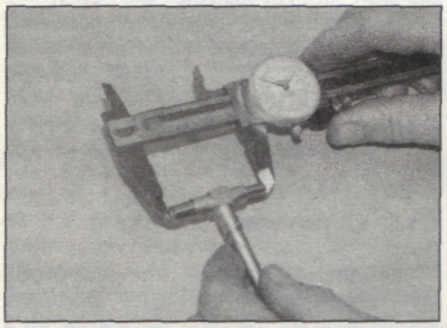
9 Check the cylinder bore carefully for scratches and score marks **(see illustration)**. A rebore will be necessary to remove any deep scores.

10 Using a telescoping gauge and a micrometer, check the dimensions of the cylinder bore to assess the amount of wear or ovality **(see illustrations)**. Measure in the area between the top of the bore (but below the level of the top piston ring at TDC), and the top of the exhaust port – measure the bore both parallel to and across the crankshaft axis **(see illustrations)**. Calculate any differences between the measurements to determine any ovality in the bore. Compare the results to the cylinder bore out-of-round service limit specifications at the beginning of this Chapter.

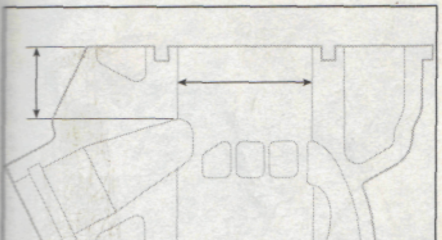
11 Calculate the piston-to-bore clearance by subtracting the piston diameter (see Section 8) from the bore diameter measured 15 mm down from the top edge of the cylinder, at 90° to piston pin axis. If the cylinder is in good condition and the piston-to-bore clearance is within specifications, the cylinder can be re-used. **Note:** *Cylinders and pistons are size-coded; on Type 122 engines, the cylinder is stamped with the size code; on Type 123 engines, the cylinder is marked with the appropriate paint colour. On all engines, the piston size is stamped on the top of the piston.*



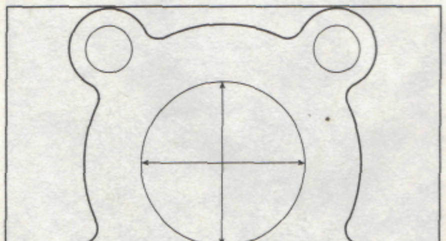
7.10a Measure the cylinder bore with the telescoping gauge . . .



7.10b . . . then measure the gauge with a Vernier



7.10c Measure the cylinder bore in the area shown . . .



7.10d . . . both parallel to, and across, the axis of the crankshaft

12 If the bore is tapered, oval, or worn, badly scratched, scuffed or scored, have it rebored by an Aprilia dealer or specialist motorcycle engineer. If the cylinder is rebored, it will require an oversize piston and rings. If the cylinder has already been rebored to the maximum oversize and is worn or damaged, a new cylinder and piston will have to be fitted.

13 Check that the cylinder studs are tight in the crankcase. If any are loose, remove them and clean their threads. Apply a suitable permanent thread-locking compound and tighten them securely – lock two nuts together on the upper end of the stud and tighten it to the specified torque setting, then remove the nuts.

Installation

14 Install the intake manifold and reed valve assembly (see Chapter 4).

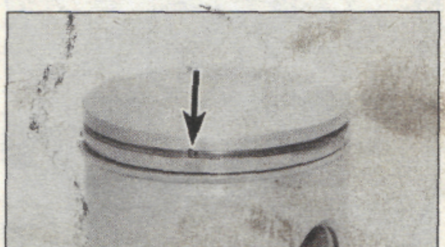
15 Check that the mating surfaces of the cylinder and crankcase are clean and remove any rag from the crankcase mouth.

16 Cylinder base gaskets are available in 0.3 mm, 0.5 mm and 0.8 mm thicknesses. To determine which thickness of gasket to use, install the cylinder and cylinder head and calculate the compression ratio as follows.

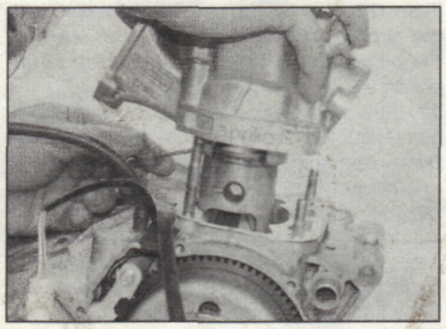
17 Lay a new base gasket, 0.5 mm thick, in place on the crankcase making sure it is the correct way round **(see illustration 7.6)**. Never re-use the old gasket – it will have become compressed.

18 Check that the piston rings are correctly positioned so that the locating pin in each piston ring groove is between the open ends of the ring **(see illustration)**. Lubricate the cylinder bore, piston and piston rings, and the connecting rod big and small ends, with two-stroke oil, then fit the cylinder down onto the rear studs until the piston crown fits into the bore **(see illustration 7.5b)**.

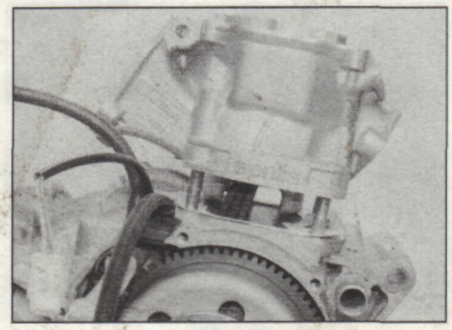
19 Gently push down on the cylinder, making sure the piston enters the bore squarely and does not get cocked sideways. Carefully compress and feed both rings into the bore as the cylinder is lowered, taking care that they



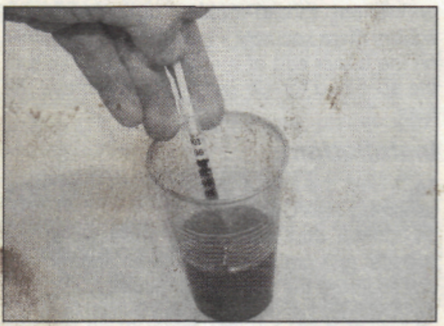
7.18 The ends of the piston ring must be aligned with the pin (arrowed) in each groove



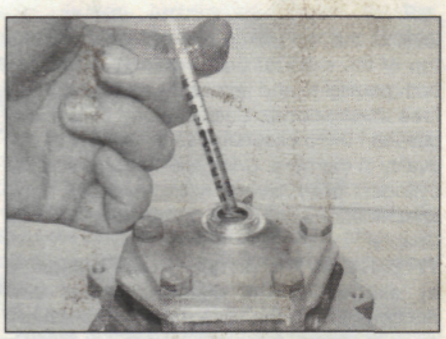
7.19 Compress the rings into the cylinder bore, ensuring they do not rotate



7.20 Press the cylinder down onto the base gasket



7.23a Using a suitably calibrated syringe . . .



7.23b . . . fill the combustion chamber to the top of the spark plug hole

do not rotate out of position **(see illustration)**. Do not use force if the cylinder appears to be stuck as the piston and/or rings will be damaged.

20 When the piston is correctly installed in the cylinder, press the cylinder down onto the base gasket **(see illustration)**.

21 Install the washers and cylinder base nuts and tighten the nuts to the torque setting specified at the beginning of this Chapter.

22 Ensure all traces of carbon have been cleaned off the piston and cylinder head, then follow the procedure in Section 6, Steps 18 to 20, and install the cylinder head.

23 Rotate the crankshaft so that the piston rises to the top of its stroke (TDC). Using a suitable calibrated syringe, fill the combustion chamber to the top edge of the spark plug hole with clean two-stroke oil, noting the exact capacity **(see illustrations)**. On the Type 122 engine shown, the combustion chamber volume measured 9.7 cc. Once the combustion chamber volume has been measured, rotate the crankshaft so that the piston falls to the bottom of its stroke (BDC) and drain the oil through the exhaust port.

24 To calculate the compression ratio, add the cylinder capacity (see Specifications at the beginning of this Chapter) and the combustion chamber volume you have measured together, then divide the total by the combustion chamber volume. For example:

$124.82 + 9.7 = 134.52 \div 9.7 = 13.86$

25 In this example, the calculated compression ratio is higher than the specification for the Type 122 engine, so a thicker cylinder base gasket must be fitted to reduce the ratio. If the calculated compression ratio is lower than the specification, a thinner gasket should be fitted to increase the ratio.

26 Having established the correct gasket thickness, fit the new gasket to the crankcase and install the cylinder (see Steps 18 to 21).

27 Install the remaining components in the reverse order of removal.

8 Piston

Note: *This procedure can be carried out with the engine in the frame. If the engine has been removed, ignore the steps that don't apply.*

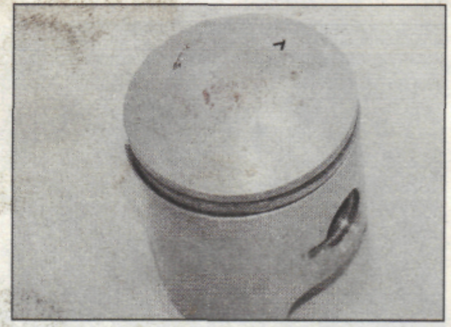
Removal

1 Remove the cylinder and stuff a clean rag into the crankcase opening around the piston to prevent anything falling inside (see Section 7).

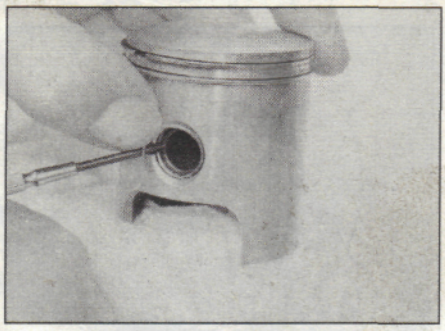
2 The piston top should be marked with an arrow which faces towards the exhaust **(see illustration)**. If this is not visible, mark the piston accordingly so that it can be installed the correct way round. Note that the arrow may not be visible until the carbon deposits have been scraped off and the piston cleaned.

3 Carefully prise the circlip out from one side of the piston using needle-nosed pliers or a small flat-bladed screwdriver in the notch provided **(see illustration)**. Check for burring around the circlip groove and remove any with a very fine file or penknife blade, then push the piston pin out from the other side and remove the piston from the connecting rod **(see illustration)**. Use a socket extension to push the piston pin out if required. Remove the other circlip and discard them both as new ones must be used on reassembly.

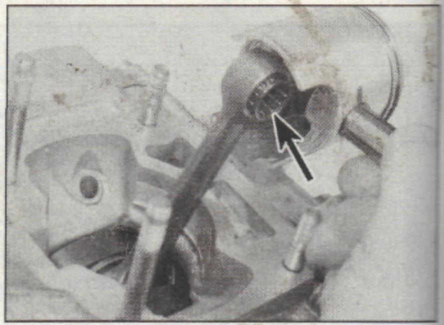
HAYNES HiNT ***To prevent the circlip from flying away or from dropping into the crankcase, pass a rod or screwdriver with a greater diameter than the gap between the circlip ends, through the piston pin. This will trap the circlip if it springs out.***



8.2 Arrow on piston crown faces the exhaust port



8.3a Prise the circlip out carefully . . .

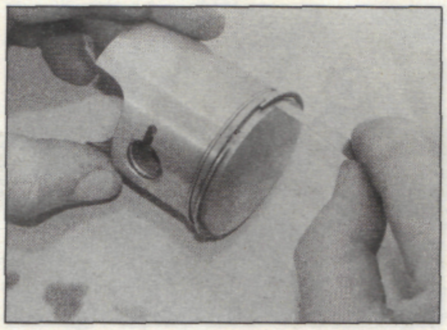


8.3b . . . then withdraw the piston pin and remove the piston. Note the small-end bearing (arrowed)

If a piston pin is a tight fit in the piston bosses, heat the piston gently with a hot air gun – this will expand the alloy piston sufficiently to release its grip on the pin.

4 The connecting rod small-end bearing is a loose fit in the rod; remove it for safekeeping, noting which way round it fits **(see illustration 8.3b)**.

5 Before the inspection process can be carried out, the piston rings must be removed and the piston must be cleaned. **Note:** *If the cylinder is being renewed or rebored, piston inspection can be overlooked as a new one will be fitted.* The piston rings can be removed by hand or with an old feeler gauge blade **(see illustration)**. Take care not to expand the rings any more than is necessary and do not nick or gouge the piston in the process.



8.5 Removing the piston rings using a thin blade

6 Note which way up each ring fits and in which groove as they must be installed in their original positions if being re-used. On some rings, the upper surface at one end is marked (see Section 9). **Note:** *It is good practice to renew the piston rings when an engine is being overhauled. Ensure the piston and bore are serviceable before purchasing new rings.*

7 Clean all traces of carbon from the top of the piston. A hand-held wire brush or a piece of fine emery cloth can be used once most of the deposits have been scraped away. Do not, under any circumstances, use a wire brush mounted in a drill motor; the piston material is soft and is easily damaged.

8 Use a piston ring groove cleaning tool to remove any carbon deposits from the ring grooves. If a tool is not available, a piece broken off an old ring will do the job. Be very careful to remove only the carbon deposits. Do not remove any metal and do not nick or gouge the sides of the ring grooves.

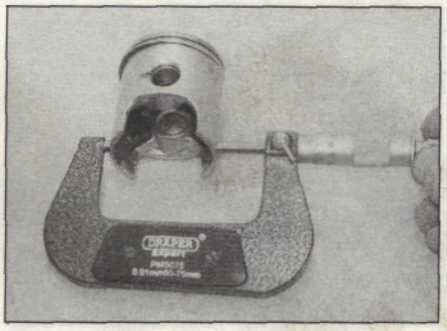
9 Once the carbon has been removed, clean the piston with a suitable solvent and dry it thoroughly. If the identification previously marked on the piston is cleaned off, be sure to re-mark it correctly.

Inspection

10 Inspect the piston for cracks around the skirt, at the pin bosses and at the ring lands. Check that the circlip grooves are not damaged. Normal piston wear appears as even, vertical wear on the thrust surfaces of the piston and slight looseness of the top ring in its groove. If the skirt is scored or scuffed, the engine may have been suffering from overheating and/or abnormal combustion, which caused excessively high operating temperatures.

11 A hole in the top of the piston, in one extreme, or burned areas around the edge of the piston crown, indicate that pre-ignition or knocking under load have occurred. If you find evidence of any problems the cause must be corrected or the damage will occur again. Refer to Chapter 4 for carburation checks and Chapter 5 for ignition checks.

12 Check the piston-to-bore clearance by measuring the bore (see Section 7) and the piston diameter. Using a micrometer, measure the piston 11.5 mm up from the bottom of the skirt and at 90° to the piston pin axis **(see illustration)**. Subtract the piston diameter from the bore diameter to obtain the clearance. If it is greater than the service limit, check whether it is the bore or piston that is worn the most. If the bore is good, install a new piston and rings.



8.12 Measuring the piston diameter with a micrometer

13 If a new piston is to be fitted, ensure the correct size of piston is ordered. Compare the piston size with the specifications at the beginning of this Chapter to determine if the piston is standard, or oversize, indicating a rebored cylinder. Note any size or size code stamped in the piston crown **(see illustration 8.2)** – when purchasing a new piston, always supply the size code.

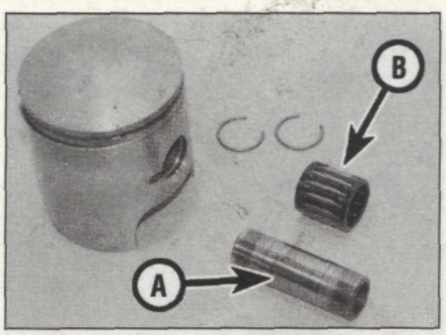
14 Measure the piston ring-to-groove clearance by laying each piston ring in its groove and slipping a feeler gauge in beside it **(see illustration)**. Make sure you have the correct ring for the groove (see Step 6). Check the clearance at three or four locations around the groove. If the ring-to-groove clearance is greater than specified, renew both the piston and rings as a set. Note that the service limit is different between Type 122 and Type 123 engines. If new rings are being used, measure the clearance using the new rings. If the clearance is greater than that specified, the piston is worn and must be renewed.

15 Use a micrometer to measure the piston pin in the middle, where it runs in the small-end bearing, and at each end where it runs in the piston **(see illustration)**. Any difference in the measurements indicates wear and the pin must be renewed.

16 If the piston pin is good, lubricate it with clean two-stroke oil, then insert it into the piston and check for any freeplay between the two **(see illustration)**. There should be no freeplay.

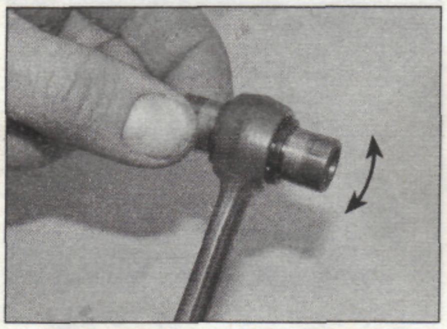
17 Check the condition of the connecting rod small-end bearing. A worn small-end bearing will produce a metallic rattle, most audible when the engine is under load, and increasing as engine speed rises. This should not be confused with big-end bearing wear, which produces a pronounced knocking noise. Inspect the bearing rollers and ensure there are no flat spots or pitting **(see illustration 8.15)**.

8.14 Measuring piston ring-to-groove clearance

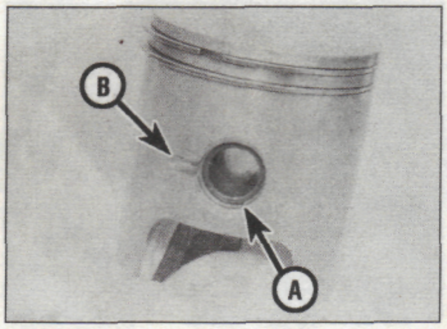


8.15 Measure the piston pin (A) as described and inspect the rollers of the small-end bearing (B)

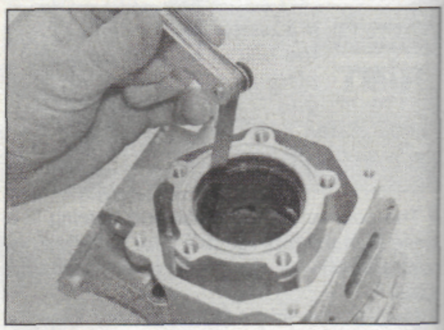
8.16 Checking for freeplay between the piston and the piston pin



8.17 **Checking for freeplay between the piston pin, small-end bearing and connecting rod**



8.20 **Locate open end of circlip (A) away from the notch (B)**



9.2 **Measuring the piston ring installed end gap**

Assemble the bearing and the piston pin on the connecting rod; there should be no discernible freeplay between the piston pin, the bearing and the connecting rod **(see illustration)**. If the piston pin is good (see Step 15), but there is freeplay in the assembly, fit a new bearing and check again. If there is still freeplay, this indicates wear in the connecting rod small-end and the connecting rod and crankshaft assembly must be renewed (see Section 17).

Installation

18 Inspect and install the piston rings (see Section 9).

19 Lubricate the piston pin, the piston pin bore in the piston and the small-end bearing with two-stroke oil. Install the bearing in the connecting rod.

20 Install a new circlip in one side of the piston (do not re-use old circlips). Line up the piston on the connecting rod, making sure the arrow on the piston crown faces towards the exhaust, and insert the piston pin from the other side **(see illustration 8.3b)**. Secure the pin with the other new circlip **(see illustration 8.3a)**. When installing the circlips, compress them only just enough to fit them in the piston, and make sure they are properly seated in their grooves. Ensure the open end of each circlip faces down – away from the notch in the side of the piston **(see illustration)**.

21 Install the cylinder (see Section 7).

9 Piston rings

1 New piston rings should be fitted whenever an engine is being overhauled. Before installing the new rings, their end gaps must be checked.

2 Insert the top ring into the top of the cylinder bore and square it up with the cylinder walls by pushing it in with the top of the piston until it is just above the exhaust port. To measure the end gap, slip a feeler gauge between the ends of the ring and compare the measurement to the specifications at the beginning of the Chapter **(see illustration)**.

3 If the gap is larger or smaller than specified, double check to make sure that you have the correct rings before proceeding.

4 Never install a piston ring with a gap smaller than specified. If the gap is larger than specified, check that the bore is not worn (see Section 7).

5 Repeat the procedure for the other ring.

6 Once the ring end gaps have been checked, the rings can be installed on the piston. First identify the ring locating pin in each piston ring groove – the rings must be positioned so that the pin is in between the open ends of the ring **(see illustration 7.18)**.

7 On some rings, the upper surface at one end is marked **(see illustration)**. Install the lower ring first, making sure that it is the right way up – fit the ring into the lower groove in the piston. Do not expand the ring any more than is necessary to slide it into place **(see illustration 8.5)**.

8 Now install the top ring into the top groove in the piston.

9 Once the rings are correctly installed, check that their open ends are positioned each side of the pins **(see illustration 7.18)**.

10 Alternator rotor and stator

Note: *This procedure can be carried out with the engine in the frame. If the engine has been removed, ignore the steps that don't apply.*

Removal

1 Remove the right-hand fairing side panel (see Chapter 8).

2 Remove the fuel tank (see Chapter 4).

3 Undo the screws securing the alternator cover and lift it off **(see illustration)**.

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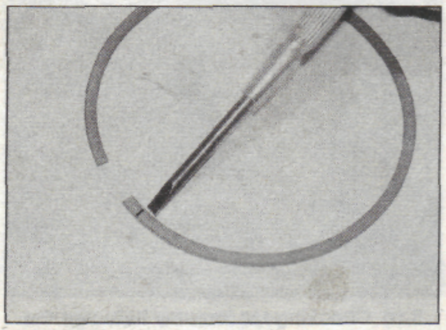
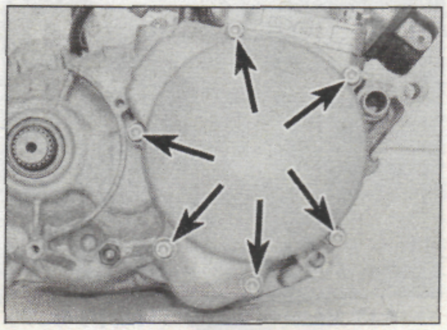
4 Lift off the starter gear cover **(see illustration)**.

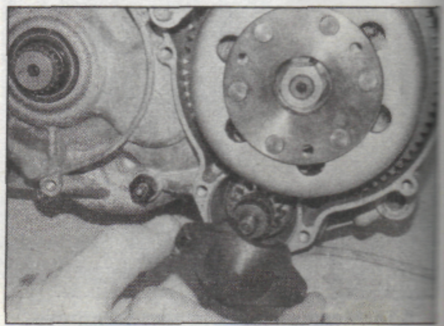
5 Undo the bolts securing the ignition pick-up coil, then pull the coil/alternator wiring seal



9.7 **The upper surface at one end of some rings is marked**



10.3 **Undo the alternator cover screws (arrowed)**



10.4 **Remove the starter gear cover**